STATE OF MISSOURI
Mel Carnahan, Governor • David A. Shorr, Director
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102-0176

February 16, 1996

Ms. Kimberly Hill
RCRA Permitting and
Compliance Branch
US EPA Region VII
726 Minnesota Ave.
Kansas City, KS 66101

RE: Revised Preliminary Remediation Goals (PRGs) Document for Soil and Groundwater, Monsanto-J.F. Queeny Plant, St. Louis

Dear Ms. Hill:

A copy of the subject document, as prepared by the Missouri Department of Health (MDOH), was previously transmitted to you on January 2, 1996. The Missouri Department of Natural Resources - Hazardous Waste Program (HWP) has completed a review of this document. An additional copy of this document is enclosed and the following comments are provided for your consideration. These comments relate to use of the calculated final soil and groundwater Preliminary Remediation Goals (PRGs) for the purpose of defining the nature and scope of further investigation to be required during the RCRA Facility Investigation (RFI) as well as potential use of the PRGs as site-specific clean-up standards.

- Final soil PRGs for some specific contaminants are extremely high, yet the corresponding final groundwater PRGs are quite low. Use of certain final soil PRGs to define areas requiring further investigation and/or remediation may be problematic given the lack of site-specific information concerning the "leachability" of contaminants from site soils. In some instances, the final soil PRGs could be protective of human health in a specific soil exposure scenario yet still represent a significant contaminant source area relative to leaching to groundwater in excess of final groundwater PRGs. Sole use of the final soil PRGs to define the nature and scope of further soil investigation during the RFI and establishment of site-specific clean-up standards appears problematic. It is recommended that other relevant factors also be taken into consideration.

The final soil PRGs are represented as protective of human health given specific exposure scenarios and assumptions. It should be noted; however, that the final soil PRGs for some contaminants under specific exposure scenarios are equivalent to the presence of an undiluted contaminant (1,000,000 mg/kg = 100% contaminant). Theoretically, given the maximum pore space available within the soil matrix, total soil contaminant concentrations should not exceed roughly 40% (400,000 mg/kg) at 100% contaminant saturation. In addition, many of the calculated final soil PRGs are in the 1-40% (1,000-400,000 mg/kg) contaminant concentration range.

- The calculated final groundwater PRGs are in many ways quite interesting and may be problematic as well. Given the industrial scenario proposed for the risk assessment, the HWP originally anticipated that the calculated final groundwater PRGs would be elevated when compared with those generated using a residential (e.g., potable water) scenario. This expectation appears to be erroneous given the specific industrial use scenario analyzed. Based on the inhalation and dermal absorption factors associated with this scenario, many of the final groundwater PRGs are well below the Maximum Contaminant Levels (MCLs) for the same contaminants in drinking water.

  Many of the final groundwater PRGs calculated under the industrial scenario are so low as to suggest potential problems with the ability to reasonably detect and/or quantify specific contaminants using currently available analytical methods and technologies. This may impact Monsanto's technical ability to perform further investigations to adequately define the extent of groundwater contamination and/or perform subsequent groundwater remediation and will no doubt bear on Monsanto's disposition with respect to undertaking such activities. This problem is further complicated by the aforementioned lack of data regarding potential leaching from highly contaminated site soils and the attendant potential impact on groundwater. Sole use of the final groundwater PRGs to define the nature and scope of further groundwater investigation during the RFI and establishment of site-specific clean-up standards appears problematic. It is recommended that other relevant factors also be taken into consideration.

- Multiplying the final soil PRGs by a factor of ten to address the exposure scenario presented in paragraph two of the cover letter accompanying the subject document results in many of the final soil PRG values exceeding 100% of the contaminant.

- Nickel has not been excluded as a Chemical of Concern (COC) as indicated near the bottom of the second paragraph on page one of the document.

- Final PRGs were not developed for many of the COCs present at the site due to "multiple toxicity data gaps." The most notable of these are the carcinogenic polynuclear aromatic hydrocarbons. The location(s) and concentration(s) of COCs which were not evaluated as part of the risk assessment should be factored into decisions regarding the need for and scope of further site investigation and/or remediation given their designation as RCRA hazardous constituents.

- The revised PRG document does not address protection of the environment in any substantive way and, as indicated in the original PRG document, suggests that substantial additional site-characterization data would be necessary to do so.

If you have any questions concerning this letter or coordination of the corrective action issues at the Monsanto facility, please contact Richard A. Nussbaum, P.E., of my staff, at (573) 751-3176.

Sincerely,

HAZARDOUS WASTE PROGRAM

Arthur H. Groner
Chief, Permits Section

AG:rnj

Enclosure

c: Robert L. Stewart, P.E., EPA Region VII
Mr. Randy Rohrman, EPA Region VII

MISSOURI DEPARTMENT OF HEALTH

Mel Carnahan
Governor

Coleen Kivlahan, M.D., M.S.P.H.
Director

P.O. Box 570, Jefferson City, MO 65102-0570 • 314-751-6400 • FAX 314-751-6010

January 2, 1996

Art Groner, Chief
Permits Section
Hazardous Waste Program
Division of Environmental Quality
Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

Dear Mr. Groner:

Attached is the revised Preliminary Remediation Goals (PRGs) document for the Monsanto-Queeny facility in St. Louis. The revised document attempts to address all comments made on the draft version. Specifically, PRGs for carcinogenic PAHs were not given because there are no inhalation slope factors for them, and because oral-to-dermal extrapolation is not appropriate. An MCL column has been added to Table 5. Also, the text has been revised to explain that the calculation of the volatilization factor includes 25 air exchanges per 8-hour shift.

Dave Crawford, of EPA Region VII, asked us to include another scenario, a worker exposed to onsite soils for four hours, once a week. The soil values associated with this scenario can be obtained by merely multiplying the Final PRG by a factor of ten. Since some areas of the Queeny facility have exposed soil and some areas are only chat-covered, this latest scenario may not be protective of the reasonably maximally exposed (RME) worker, but would probably be protective of the average Queeny employee.

If you have any questions regarding the revisions or the PRGs, please contact me at (573) 751-6404.

Sincerely,

Randall D. Maley, M.P.H.
Environmental Specialist III
Bureau of Environmental Epidemiology

RDM/mw

cc: Kim Hill, EPA Region VII
Randy Rohrman, EPA Region VII

Preliminary Remediation Goals for Soil and Groundwater at the Monsanto-Queeny Facility, St. Louis, Missouri

Prepared by:

Missouri Department of Health
Bureau of Environmental Epidemiology
210 El Mercado Plaza
Jefferson City, MO 65109

The Monsanto-Queeny facility is an active chemical manufacturing plant located in St. Louis, approximately a mile south of the Gateway Arch. The plant is the original home of Monsanto, and has been in continuous operation since 1902. As a result of plant operations, soils and groundwater at the site are contaminated with a variety of chemicals. The U.S. Environmental Protection Agency (EPA) asked the Missouri Department of Health to calculate preliminary remediation goals (PRGs) for the facility. EPA requested that PRGs be calculated using Superfund methodology.

Over the years, chemicals as diverse as aspirin and weedkillers have been produced at the facility; consequently, the contaminants found onsite include a wide variety of metals, volatile organics, semi-volatile organics, polynuclear aromatic hydrocarbons, polychlorinated biphenyls, and pesticides. The list of chemicals detected at the site is supplied as Table 1. Not all chemicals found at the site were considered to be Chemicals of Concern (COCs). Chemicals which were only detected once in groundwater were excluded as groundwater COCs. The chemicals excluded were: 1,1-dichloroethane, 1,1-dichloroethene, 1,2,4-trichlorobenzene, 1,3-dichlorobenzene, 2-nitrophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 2,4,6-trichlorophenol, 4-chloro-3-methylphenol, 4,6-dinitro-2-methylphenol, acenaphthylene, acetophenone, beryllium, bis(2-chloroethyl)ether, cobalt, di-n-butylphthalate, di-n-octylphthalate, ethyl benzene, molybdenum, and pentachlorophenol. Metals which were excluded as soil COCs based on comparison to background concentrations were aluminum, calcium, cobalt, magnesium, molybdenum, nickel, potassium, silver, sodium, titanium, and vanadium.

Table 1
Chemicals Found in Soil and/or Groundwater at the
Monsanto-Queeny Facility, St. Louis, MO

1,1,1-Trichloroethane
1,2,4-Trichlorobenzene
1,2-Dichlorobenzene
1,2-Dichloroethene (cis)
1,2-Dichloroethene (trans)
1,4-Dichlorobenzene
2-Butanone
2-Chlorophenol
2-Methylnaphthalene
4-Chloroaniline
4-Phenylenediamine
Acenaphthene
Acetone
Alachlor
Aluminum
Aniline
Anthracene
Arochlor-1248
Arochlor-1254
Arsenic
Barium
Benzene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(ghi)perylene
Benzo(k)fluoranthene
Beryllium
Bis(2-ethylhexyl)phthalate
Cadmium
Calcium
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroform
Chromium III
Chrysene
Copper
Cyanide
Dibenz(a,h)anthracene
Dibenzofuran
Diethylphthalate
Ethyl methacrylate
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
Indomethane
Iron
Lead
Magnesium
Manganese
Mercury
Methylene chloride
Naphthalene
Nickel
Phenanthrene
Phenol
Potassium
Pyrene
Selenium
Silver
Sodium
Sulfide
Tetrachloroethene
Tin
Toluene
Trichloroethene
Vanadium
Vinyl chloride
Xylenes
Zinc

Occupational exposure to soils and groundwater were considered separately in this document. The two soil exposure scenarios which were considered are occupational with, and without, excavation. Soil PRGs for the scenario without excavation are intended to protect workers from adverse health effects from exposure to contaminated air and exposed surface soil. This scenario assumes a worker would be exposed through inhalation and dermally through exposed hands, forearms and face. These workers were assumed to work 8 hours per day, 250 days per year. The excavation scenario is designed to protect plant employees, construction workers, and others who might come into contact with contaminated soils through excavation. The most plausible occurrences of this would be through maintenance of sewer lines or underground pipes, or from new construction. The exposure values used in calculating PRGs for this scenario were 8 hours per day, 15 days per year, for 25 years. Realistic exposure values for two major construction projects - 10 hours per day, 150 days per project, times two projects, also corresponds to 3000 total hours of exposure. Therefore, PRGs for either excavation scenario would be identical.

The Groundwater PRGs were calculated to protect a future industrial worker who would have contact with industrial process water. The specific scenario was for a hypothetical electroplating facility. Exposure to these workers would be through inhalation of contaminants volatilized from groundwater, and through waterborne contaminants being absorbed through the skin. Exposure to soil and groundwater were considered separately since a worker would not be exposed to both media at the same time.

The formulas used for calculating PRGs for carcinogenic and noncarcinogenic endpoints are listed in Table 2. Definitions of exposure variables and values used in the equations for each of the various scenarios are presented as Table 3. The formulas were modified from equations found in EPA's Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part A, EPA, 1989) and Part B: Development of Risk-Based Preliminary Remediation Goals (EPA, 1991a). The units of measurement for PRGs are milligrams per liter (mg/l) for water and milligrams per kilogram (mg/kg) for soil.

Values used in calculating water-to-air concentrations were obtained from EPA guidance and from data collected as part of an investigation of an electroplating facility. K, the Volatilization Factor, was calculated by dividing the amount of water used by an electroplater by the size of the building and the amount of air exchange. The amount of water used daily and the dimensions of the facility were historical data from the Quality Plating site, a defunct facility in southeast Missouri. In determining K, the values used were 10,000 gallons of water per day, a facility of 1008 cubic meters (21 m x 12 m x4 m), and 25 air exchanges per 8 hour shift.

Table 2

Formulas used for Calculating Preliminary Remediation Goals (PRGs) at the Monsanto-Queeny Facility, St. Louis, MO

Soil

Carcinogenic:

$$PRG = \frac{TR \times BW \times AT \times 365\ days/year}{EF \times ED \times \{(SFo \times IRs \times 1E\text{-}6\ kg/mg) + [SFi \times IRa \times (1/VF + 1/PEF)] + (SFd \times SAx\ ABS \times AF \times 10E\text{-}6\ kg/m)\}}$$

Noncarcinogenic:

$$PRG = \frac{THI \times BW \times AT \times 365\ days/year}{EF \times ED \times \{[(1/RfDo) \times IRs \times 1E\text{-}6\ kg/mg] + [(1/RfDi) \times IRa \times (1/VF + 1/PEF)]\}}$$

Groundwater

Carcinogenic:

$$PRG = \frac{TR \times BW \times AT \times 365\ days/year}{EF \times ED \times [(SFi \times IRa \times K) + (SFd \times ET \times PC\ SA \times .001\ l/m^3)]}$$

Noncarcinogenic:

$$PRG = \frac{THI \times BW \times AT \times 365\ days/year}{EF \times ED \times \{[(1/RfDi) \times IRa \times K] + [(1/RfDd) \times ET \times PC \times SA \times .001\ l/m^3]\}}$$

Table 3
Variable Values Used to Calculate Preliminary Remediation Goals for Soil and Groundwater at the Monsanto-Queeny Site, St.Louis, MO

Variable	Abbreviation	Adult Worker	Excavation Worker*	Worker w/ Water Exposure
Target Hazard Index	THI	1 (Defined by EPA)	1 (Defined by EPA)	1 (Defined by EPA)
Target Risk	TR	10^{-6} (Defined by EPA)	10^{-6} (Defined by EPA)	10^{-6} (Defined by EPA)
Body Weight (kg)	BW	70	70	70
Averaging Time - Carcinogenic (years)	AT	70	70	70
Averaging Time - Noncarcinogenic (years)	AT	25	25	25
Exposure Frequency (days/year)	EF	250	15	250
Exposure Duration (years)	ED	25	25	25
Oral Reference Dose (mg/kg/day)	RfDo	Chemical Specific**	Chemical Specific**	Chemical Specific**
Inhalation Reference Dose (mg/kg/day)	RfDi	Chemical Specific**	Chemical Specific**	Chemical Specific**
Dermal Reference Dose (mg/kg/day)	RfDd	Chemical Specific**	Chemical Specific**	Chemical Specific**
Soil Ingestion Rate (mg/day)	IRs	50	50	Not Applicable
Inhalation Rate (m^3/day)	IRa	20	20	20
Oral Slope Factor (per mg/kg/day)	SFo	Chemical Specific**	Chemical Specific**	Chemical Specific**
Inhalation Slope Factor (per mg/kg/day)	SFi	Chemical Specific**	Chemical Specific**	Chemical Specific**
Dermal Slope Factor (per mg/kg/day)	SFd	Chemical Specific**	Chemical Specific**	Chemical Specific**
Surface Area Exposed (cm^2)	SA	4123	4123	4123
Permeability Constant (cm/hr)	PC	Chemical Specific**	Chemical Specific**	Chemical Specific**
Exposure Time (hr)	ET	8	8	8
Volatilization Factor (l/m^3)	K	Not Applicable	Not Applicable	1.5
Soil to Air Volatilization Factor	VF	Chemical Specific**	Chemical Specific**	Not Applicable
Particulate Emissions Factor (m^3/kg)	PEF	4.63E+9	4.63E+9	Not Applicable
Dermal Absorption	ABS	Chemical Specific**	Chemical Specific**	Not Applicable
Adherence Factor	mg/ cm^2	1	1	Not Applicable

* Exposure values are for minor excavation scenario. Total exposure (3000 hrs.) is the same as for a major excavation (10 hour/day x 150 days/year x 2 years)

** Chemical specific values are listed in Appendix I

Toxicity values used in the calculation of PRGs are listed in Appendix I. Most of the values used were obtained from the EPA's Integrated Risk Information System (IRIS, EPA, 1995). Other sources used included Health Effects Assessment Summary Tables (HEAST, EPA, 1994) and the National Center for Environmental Assessment (NCEA). The hierarchy used for determination of values was IRIS, then HEAST, then, if neither source had a published value, NCEA. Chemical constants were obtained from NCEA or from the National Library of Medicine's Hazardous Substance Data Base (HSDB).

PRGs can only be calculated if the necessary toxicity information is available. If toxicity values could not be obtained, or if route-to-route extrapolation was deemed inappropriate, one or more pathways can not be evaluated. In this document, only one route of exposure was caculated for some chemicals. For a groundwater COC for example, if no inhalation reference dose was available, only the dermal route of exposure was calculated. Chemicals for which PRGs were not calculated because of multiple toxicity data gaps were:

2-Methylnaphthalene
Aluminum
Benzo(g,h,i)perylene
Calcium
Carcinogenic PAHs
Dibenzofuran
Ethane Sulfonic Acid
Indomethane
Iron
Lead
Magnesium
Phenanthrene
Potassium
Sodium
Sulfide

PRGs are presented in Tables 4 and 5. Carcinogenic and noncarcinogenic PRGs were calculated; the more conservative value was listed as the final PRG. If one wished to calculate a PRG for a worker who was only exposed to onsite soils on a sporadic basis (4 hours once per week), you need only multiply the Final PRGs listed in Table 4 by a factor of ten. The worksheets which were used to calculate PRGs are presented as Appendix II.

Table 4
Preliminary Remediation Goals (PRGs) for Soil at the Monsanto-Queeny Facility, St. Louis, MO

PRGs (in mg/kg)	Excavation Scenario			Worker Scenario		
Chemical	Carcinogenic	Noncarcinogenic	**Final PRG**	Carcinogenic	Noncarcinogenic	**Final PRG**
Volatiles						
1,1,1-Trichloroethane	-	1000000	**1000000**	-	180000	**180000**
Carbon Disulfide	-	1000000	**1000000**	-	200000	**200000**
Carbon Tetrachloride	730	24000	**730**	44	1200	**44**
Chlorobenzene	-	920	**920**	-	55	**55**
Ethyl Methacrylate	-	1000000	**1000000**	-	180000	**180000**
Methyl Ethyl Ketone	-	400000	**400000**	-	24000	**24000**
Methylene Chloride	69	34000	**69**	4.1	2000	**4.1**
Toluene	-	17000	**17000**	-	1000	**1000**
Trichloroethene	8300	200000	**8300**	500	12000	**500**
Xylenes	-	1000000	**1000000**	-	140000	**140000**
Semivolatiles						
Acenaphthene	-	24000	**24000**	-	1500	**1500**
Anthracene	-	120000	**120000**	-	7300	**7300**
Benzo(a)anthracene	130	-	**130**	7.8	-	**7.8**
Benzo(a)pyrene	13	-	**13**	.78	-	**.78**
Benzo(b)fluoranthene	130	-	**130**	7.8	-	**7.8**
Benzo(k)fluoranthene	1300	-	**1300**	78	-	**78**
Chrysene	13000	-	**13000**	780	-	**780**
Dibenz(a,h)anthracene	13	-	**13**	.78	-	**.78**
Fluoranthene	-	8200	**8200**		490	**490**
Fluorene	-	16000	**16000**		980	**980**
Indeno(1,2,3-cd)pyrene	130	-	**130**	7.8	-	**7.8**

Table 4 Continued

PRGs in Soil (in mg/kg)	Excavation Scenario			Worker Scenario		
Chemical	Carcinogenic	Noncarcinogenic	**Final PRG**	Carcinogenic	Noncarcinogenic	**Final PRG**
p-Chloroaniline	-	1600	**1600**	-	98	**98**
p-Phenylenediamine	-	78000	**78000**	-	4700	**4700**
Pyrene	-	12000	**12000**	-	730	**730**
Metals						
Arsenic	59	9400	**59**	3.5	560	**3.5**
Barium	-	136000	**136000**	-	8200	**8200**
Beryllium	20	18000	**20**	1.2	1100	**1.2**
Cadmium	175000	970	**970**	11000	58	**58**
Copper	-	110000	**110000**	-	66000	**66000**
Manganese	-	9700	**9700**	-	580	**580**
Mercury, inorganic	-	6600	**6600**	-	400	**400**
Nickel	-	680000	**680000**	-	22000	**22000**
Selenium	-	84000	**84000**	-	5000	**5000**
Tin	-	1000000	**1000000**	-	330000	**330000**
Zinc	-	1000000	**1000000**	-	610000	**610000**
Alachlor	28	8100	**28**	1.7	480	**1.7**
Arochlor-1248	-	63	**63**	-	3.8	**3.8**
Arochlor-1254	-	63	**63**	-	3.8	**3.8**

Table 5
Preliminary Remediation Goals for Groundwater
at the Monsanto-Queeny Facility, St. Louis, MO

PRGs (in mg/l)

Chemical	Carcinogenic	Noncarcinogenic	MCL	**Final**
Volatiles				
1,2-Dichloroethene (cis)	-	62	.07	**62**
1,2-Dichloroethene (trans)	-	120	.1	**120**
Acetone	-	.29	-	**.29**
Benzene	.00029	.0068	.005	**.00029**
Carbon Disulfide	-	.68	-	**.68**
Chlorobenzene	-	.0089	.1	**.0089**
Chloroform	.00012	3.1	.1/.08	**.00012**
Methylene Chloride	.006	-	.005	**.006**
Tetrachloroethene	.0048	.063	.005	**.0048**
Toluene	-	.22	1	**.22**
Trichloroethene	.0011	.092	.005	**.0011**
Vinyl Chloride	.00003	-	.002	**.00003**
Xylenes	-	5.3	10	**5.3**
Semivolatiles				
1,2-Dichlorobenzene	-	.13	.6	**.13**
1,4-Dichlorobenzene	.0012	.59	.075	**.0012**
1,2,4-Trichlorobenzene	-	.28	.07	**.28**
2-Butanone	-	1.0	-	**1.0**
4-Chloroaniline	-	2.0	-	**2.0**
Aniline	.038	.001	-	**.001**
Bis(2-ethylhexyl)phthalate	.014	-	.006	**.014**
Fluoranthene	-	12	-	**12**
Naphthalene	-	1.4	-	**1.4**
Phenol	-	210	-	**210**
Metals				
Arsenic	.00000019	.90	.05	**.00000019**
Barium	-	.00034	2	**.00034**
Cadmium	.0000015	.093	.005	**.0000015**
Chromium (hexavalent)	.00000023	.00034	-	**.00000023**
Cyanide	-	6.2	.2	**6.2**
Manganese	-	.000034	-	**.000034**
Mercury	-	.00031	.002	**.00031**
Vanadium	-	.072	-	**.072**
Zinc	-	460	-	**460**
Alachlor	.0077	2.2	.002	**.0077**

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